ANDRYUKHIN, V.S.; FEDULIN, L.Ye.; SHKURUPIY, P.L.

Chain pusher. Gor. zhur. no.9:74 S '63. (MIRA 16:10)

FEDULKINA, N.T., aspirantka

Wages paid to workmen engaged in the current maintenance of the track. Trudy MIIT no.116:104-119 '59. (MIRA 12:11)
(Railroads--Salaries, pensions, etc.)

FEDULKINA, N.T., inzh.

Mechanization and wages in current track maintenance. Trudy MIIT no.122:420-429 '59. (MIRA 13:5)
(Railroads--Salaries, pensions, etc.)
(Railroads--Maintenance and repair)

MAMUREVICH, S.; VOZ'YANSKIY, N.; FEDULOV, A.

Using circular strips for retreading tires. Avt. transp. 36 no.2: 28 F '58. (MIRA 11:2)
(Tires, Rubber--Repairing)

FEDULOV, A.F.

Cleaning the canals under bridges. Torf.prom. 31 no.6:30 '54.
(MLRA 7:9)

1. Torfopredpriyatiye Godylevo.
(Dredging machinery)

SOV/86-58-10-38/40

AUTHOR: Fedulov, A.F., Engr Col, Candidate of Technical Sciences

TITLE: Something New in Aircraft Strength Calculation (Novoye v raschete samoleta na prochnost')

PERIODICAL: Vestnik vozdushnogo flota, 1958, Nr 10, pp 89-91 (USSR)

ABSTRACT: Critical review of the book "Aircraft Strength Calculation" (Raschet samoleta na prochnost') by S.N. Kan and I.A. Sverdlov, published by the State Publishing House of the Defense Industry, Moscow, 1958, 292 pages.

Card 1/1

FEDULOV, A.F., inzh.-polkovnik, kand.tekhn.nauk

"Design and performance of airplane parts" by A.B. Protopopov, V.I. Zhulev. Reviewed by A.F. Fedulov. Vest.Vozd.Fl. 41 no.2: 88-89 F '59. (MIRA 12:4)
(Airplanes--Design and construction)
(Protopopov, A.B.) (Zhulev, V.I.)

FEDULOV, A.I., kandidat tekhnik nauk.

Problem of cutting frozen ground. Mekh.stroi. 10 no.5:10-13 My '53.
(MLRA 6:6)
(Frozen ground)

RODIONOV,G.V., kandidat tekhnicheskikh nauk; FEDULOV,A.I., kandidat tekhnicheskikh nauk; VLADIMIROV,V.M., inzhener; GUSKOV,K.S., inzhener

Development of a specialized excavator for digging trenches with sloping sides. Mekh. stroi. 12 no.6:9-13 Je '55.
(Excavating machinery) (MLRA 8:6)

FEDULOV, A.I., kandidat tekhnicheskikh nauk

New type of machine for digging silo trenches. Sel'khozmashina no15:22-24 My '55. (MLRA 8:6)

1. Zapadno-Sibirskiy filial AN SSSR.
(Excavating machinery)

FEDULOV, A.I., kandidat tekhnicheskikh nauk; VLADIMIROV, V.M., inzhener.

On increasing the productivity of multibucket trench excavators having inclined bucket ladder. Stroi. i dor. mashinostr. 1 no.3:10-11 Mr '56. (MIRA 10:1)

(Excavating machinery)

RODIONOV, G.V.; FEDULOV, A.I.; GURKOV, K.S.

Experimental investigation of vibration ore drawing from blocks. Trudy Inst.gor.dela Sib.otd.AN SSSR no.2:189-194 '59. (MIRA 13:5)

(Mining engineering) (Vibrators)

FEDULOV, A.I.; KAMENSKIY, V.V.

Selection of specifications for an excavator bucket with impact teeth. Izv.Sib.otd.AN SSSR no.6:17-29 '60. (MIRA 13:9)

1. Institut gornogo dela Sibirskogo otdeleniya AN SSSR.
(Excavating machinery)

FEDULOV, A.I.

History of the development and use of percussion mining machines. Trudy Inst. gor. dela Sib. otd. AN SSSR no.6:21-35 '61. (MIRA 15:9)

(Mining machinery)

FEDULOV, A.I.

Breaking rocks with an impact load. Trudy Inst. gor. dela Sib. otd. AN SSSR no.6:37-62 '61. (MIRA 15:9)
(Rocks—Testing) (Mining machinery)

FEDULOV, A.I.; KAMENSKIY, V.V.; SERPENINOV, B.N.; AKULOV, Ye.F.

Laboratory testing machine for studying the breaking of rocks with an impact load. Trudy Inst. gor. dela Sib. otd. AN SSSR no.6:63-77 '61. (MIRA 15:9)

(Rocks—Testing)

FEDULOV, A.I.; KAMENSKIY, V.V.; SERPENINOV, B.N.

Unit for studying strains caused by a blow. Trudy Inst. gor. dela Sib. otd. AN SSSR no.6:79-89 '61. (MIRA 15:9)
(Rocks—Testing) (Strains and stresses)

FEDULOV, A.I.; KAMENSKIY, V.V.; SERPENINOV, B.N.

Measuring forces in impact loads. Trudy Inst. gor. dela Sib. otd. AN SSSR no.6:99-114 '61. (MIRA 15:9)
(Cathode ray oscillograph) (Rocks—Testing)

RODIONOV, G.V.; FEDULOV, A.I.; KAMENSKIY, V.V.; VIKHLYAYEV, A.A.

Secondary crushing of rocks by the breaking method. Trudy Inst. gor. dela Sib. otd. AN SSSR no.6:115-121 '61. (MIRA 15:9)
(Ore dressing)

FEDULOV, A.I.; KAMENSKIY, V.V.; NOSIKOV, G.M.

Some layouts of units for crushing oversized ores under mine conditions. Trudy Inst. gor. dela Sib. otd. AN SSSR no.6:123-130 '61. (MIRA 15:9)

(Ore dressing—Equipment and supplies)

FEDULOV, A.I.; KAMENSKIY, V.V.; TAGIN, G.F.; NOSIKOV, G.M.

Suspenden unit for crushing oversized ores in open-pit mines. Trudy Inst. gor. dela Sib. otd. AN SSSR no.6:131-138. '61. (MIRA 15:9)

(Ore dressing—Equipment and supplies)

FEDULOV, A.I.

Use of heavy percussive machinery. Fiz.-tekh. probl. razrab. pol. iskop. no.1:53-59 '65. (MIRA 18:10)

1. Institut gornogo dela Sibirskogo otdeleniya AN SSSR, Novosibirsk.

FEDULOV, I. F.

PHASE I TREASURE ISLAND BIBLIOGRAPHICAL REPORT AID 741 - I

BOOK Call No.: AF476498

Authors: FEDULOV, I. F., KIREEV, V. A.
Full Title: TEXTBOOK OF PHYSICAL CHEMISTRY 3rd ed., rev. and suppl.
Transliterated Title: Uchebnik fizicheskoy khimii, 3-ye izd., pererab. i dop.

PUBLISHING DATA
Originating Agency: None
Publishing House: State Scientific and Technical Publishing House of Chemical Literature ("Goskhimizdat")
Date: 1952 No. pp.: 440 No. of copies: 25,000
Editorial Staff: None

PURPOSE: A textbook for technical schools of the Ministry of Chemical Industry which also may serve as a manual of physical chemistry for students of technical schools not specializing in chemistry.

TEXT DATA
Coverage: This textbook discusses briefly the following topics: the most important properties of substances in gaseous, liquid and crystallized state; the structure of atoms and molecules; the laws of thermodynamics and their application to chemical processes (thermochemistry, equilibrium in homogeneous and heterogeneous systems); the phase-law; the properties of solutions; electrochemistry; the study of the rate of chemical reactions; catalysis; and the properties of substances in the

Uchebnik fizicheskoy khimii, 3-ye izd., pererabi i dop. AID 741 - I

colloidal state. The last chapter deals with the atomic nucleus, radioactivity, isotopes and nuclear reactions. A short outline of the development of physical chemistry in Russia is given in the Introduction. The book is based mainly on the work of Russian scientists. The book contains a Subject Index, as well as problems for students at the end of some chapters. It is provided with tables and diagrams. The first two editions of this work (1940, 1946) had favorable reviews and a wide circulation. This third edition is radically modified, since some chapters are rewritten anew, some errors corrected, the terminology mad more precise, and new information is added.

No. of References: None

Facilities: Many names of Russian and Soviet scientists are scattered through the book.

2/2

FEDULOV, I.F.; KIREYEV, V.A. [authors]; BALEZIN, S.A., professor [reviewer].

For thorough study of the theoretical bases of chemistry. ("Textbook of physical chemistry for technical schools." I.F.Fedulov, V.A.Kireev. Reviewed by S.A.Balezin). Khim.v shkole no.5:75-76 S-O '53. (MLRA 6:9)
(Chemistry, Physical and theoretical) (Fedulov, I.F.) (Kireev, V.A.)

FEDULOV, I.F. ; KIREYEV, V.A.; YEGOROV, N.G.redaktor; LUR'YE,M.S., tekhnicheskiy redaktor.

[Textbook of physical chemistry] Uchebnik fizicheskoi khimii. 4-e izd. Moskva, Gos. nauchno-tekhn. izd-vo khim. lit-ry, 1954. 487 p. (Chemistry, Physical and theoretical) (MLRA 8:6)

KARPOV, L.I., kand.tekhn.nauk, dotsent; FEDULOV, I.G., assistent

Regulation of the speed of the bottom tapered drum of the pedal regulator of the scutching machine. Tekst.prom. 25 no.1:39-41 Ja '65. (MIRA 18:4)

1. Ivanovskiy tekstil'nyy institut (for Karpov).

GORDON, M.B.; RYABCHIKOV, A.N.; PODGORKOV, V.V.; FEDULOV, I.G.

Automation of units supplying atomized fluid to cutting area.
Stan.i instr. 33 no.2:30-31 F '62. (MIRA 15:1)
(Metalworking lubricants)

KUSHLIN, T.V.; FEDULOV, I.I.

Organization of flawless production in the Kuznetsk Shoe Factory. Kozh.-obuv. prom. 7 no. 10:24-27 O '65 (MIRA 19:1)

1. Direktor Kuznetskoy obuvnoy fabriki (for Kushlin). 2. Glavnyy inzhener Kuznetskoy obuvnoy fabriki (for Fedulow).

FEDULOV, I.V., inzh-teplotekhnik (Omskaya doroga); KUROCHKIN, V.G., mashinist teplovoza (Omskaya doroga)

Some advice on fuel system maintenance. Elek. i tepl. tiaga 3 no.4:19-20 Ap '59. (MIRA 12:7)
(Diesel locomotives--Maintenance and repair)

LUKIN, V.I.; FEDULOV, I.V.

Cases of involuntary turning of the reversing device on the N8 electric locomotive. Elek.i tepl.tiaga 7 no.1:35-36 Ja '63. (MIRA 16:2)

1. Mashinist-instruktor depo Petropavlovsk Yuzhno-Ural'skoy dorogi (for Lukin). 2. Starshiy inzh.-teplotekhnik depo Petropavlovsk Yuzhno-Ural'skoy dorogi (for Fedulov).

(Electric locomotives)

FEDULOV, L.G.; KUZ'MENKO, V.K., kand.tekhn.nauk

Cold breaking of rod metal. Mashinostroitel' no.9:34 S '62. (MIRA 15:9)
(Machine-shop practice)

CHERNICHKIN, D.S.; BORISENKO, N.I.; MESHCHERYAYKOV, K.N.; KOMAR, Ye.G.; FEDULOV, L.N.; KOZLINSKIY, V.A.; MAKSIMOV, A.S.; GEL'PERIN, B.B.

Professor D. V. Efremov; obituray. Elektrichestvo no.2:95-96 F '61. (MIRA 14:3)

(Efremov, Dmitrii Vasil'evich, 1900-1961)

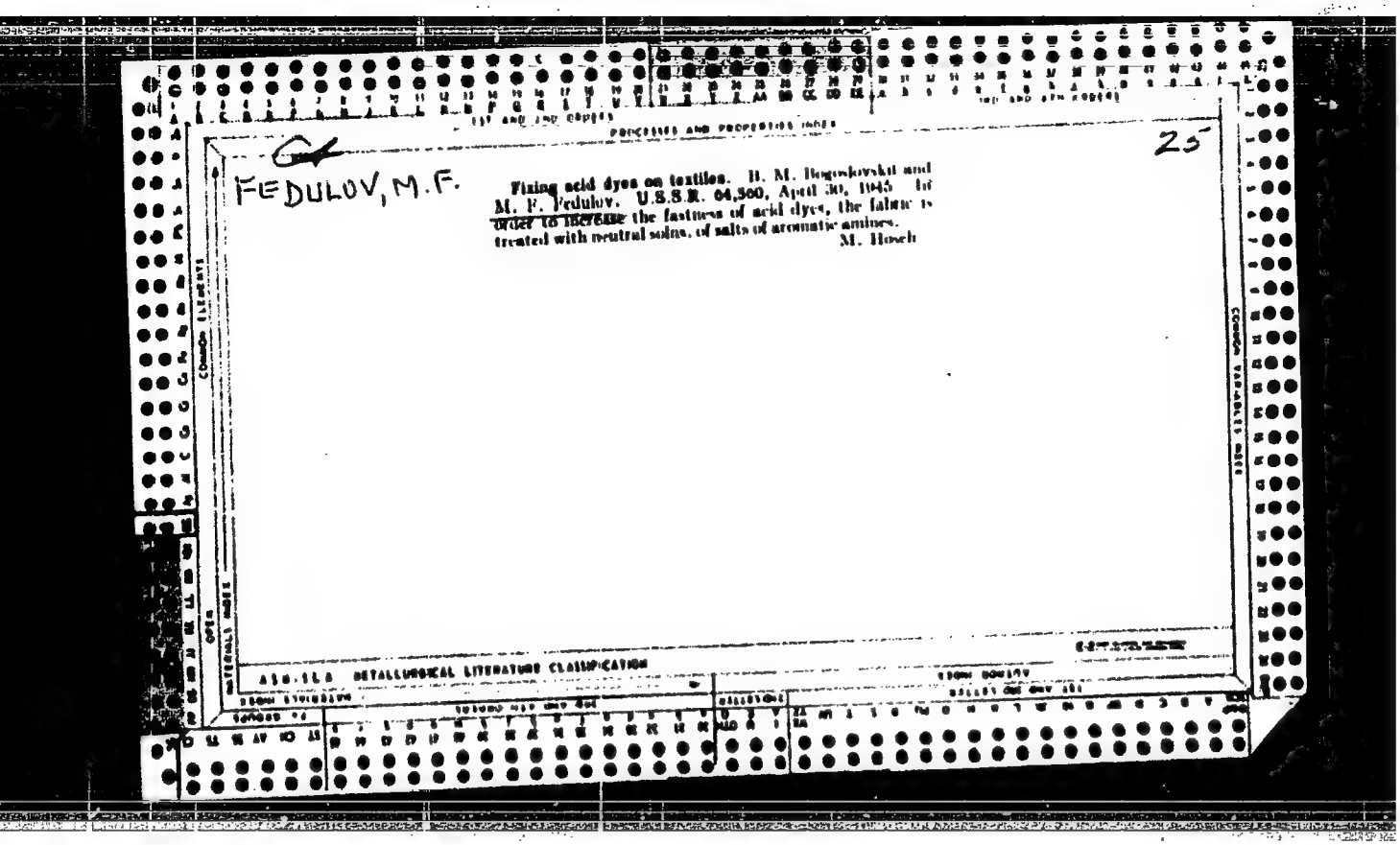
URUSOV, I.D., doktor tekhn.nauk; FEDULOV, L.N., inzh.; FEDOROV, V.F., inzh.

Artificial damping in large synchronous machines. Elektrichestvo no.7:13-18 Jl '61. (MIRA 14:9)
(Electric machinery, Synchronous)

FEDULOV, M.F., VOROZHTSOV, N.N., KOZLOV, V.V. and students; ARISTOV, B.V., BARYSHEV, A.I.

"Researches On the Naphthalene Series--IX. Regrouping the Salts 1-Naphthylamine-4-Sulfo Acid In The Salt 1-Naphthylamine-2-Sulfo Acid." Zuhr. Obshch. Khim., 10, No. 10, 1940. Lab. of Dyestuffs, Moscow Chemico-Technolcgical Inst. imeni D. I. Mendeleyev. Received 9 November 1939.

[redacted] Report U-1627, 11 January 1952.



G

FEDULOV, M.F.

25

Fixing acid dyes on textiles. B. M. Bogoslovskii and M. F. Fedulov. U.S.S.R. 64,500, April 30, 1945. In order to increase the fastness of acid dyes, the fabric is treated with neutral salts of aromatic amines.
M. Hosch

24.7500

39749
S/126/62/014/001/001/018
E032/E414

AUTHOR: Fedulov, M.V.

TITLE: Dependence of the number of defects in a single crystal on the direction of irradiation

PERIODICAL: Fizika metallov i metallovedeniye, v.14, no.1, 1962, 10-16

TEXT: J.B.Gibson et al (Phys. Rev. v.120, 1960, 305) have shown that the threshold energy E_d for the formation of Frenkel' pairs in Cu depends on the direction of the incident radiation relative to the crystallographic axes. In this paper an estimate is made of the number of defects, produced by electrons or γ-rays in single crystals near the threshold, as a function of direction in the crystal. In the case of electrons, the calculation is based on the angular distribution of electrons scattered in the crystal which was given by H.W.Lewis (Phys. Rev., v.78, 1950, 526). The small-angle approximation is employed and an approximate formula is derived for the probability W for the production of a pair. The calculation is also repeated for γ-rays, leading to the corresponding expression for W. The theory is then specialized

Card 1/2

Dependence of the number ...

to the case of Cu. Analysis of the formulas obtained leads to the conclusion that there is a considerable angular asymmetry in W even for initial energies considerably different from the threshold energy. Comparison of this theory with experiment may throw light on interatomic forces in a crystal. There is 1 table.

ASSOCIATION: Institut metallovedeniya i fiziki metallov TsNIIChM (Institute of Science of Metals and Physics of Metals TsNIIChM)

SUBMITTED: October 12, 1961

Card 2/2

L 6584-65 EWT(m)/EWA(h) DM

ACCESSION NR: AP5009112 S/0089/65/018/003/0232/0238

10
B

AUTHOR: Fedulov, M. V.

TITLE: Use of the method of moments to solve the equation of neutron thermalization in an infinite medium

SOURCE: Atomnaya energiya, v. 18, no. 3, 1965, 232-238

TOPIC TAGS: neutron thermalization, neutron density, neutron moderation, integral equation, Ritz method, method of moments

ABSTRACT: The equation solved for the neutron density N(x) is taken in the form

$$[w(x)+V(x)]N(x)-\int_0^\infty G(x,x')N(x')dx'=0.$$

where x is the neutron velocity in units of $(2kT/m)^{1/2}$, where T is the temperature of the medium in K, m is the mass of the neutron, k is Boltzmann's constant, G(x, x')dx is the probability that in a unit time a scattered neutron with velocity x' acquires a velocity in the

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ACCESSION NR: AP5009112

interval x, x + dx, V(x) is the probability of experiencing scattering, and w(x) is the capture probability. It is shown that since the kernel of the equation G(x, x') can be reduced to symmetrical form as a result of the principle of detailed balancing, the equation for an infinite homogeneous medium can be solved by the method of moments, which can be reduced to the Ritz variational principle in the case of a symmetrical kernel. The results are compared with the exact solution for the case of a monoatomic gas with a scattering cross section independent of the relative velocity, using moderator masses of 1 and 20. The analysis shows that the accuracy of the results of the method of moments are closer to the exact calculation than the results obtained with a Maxwellian spectrum. "The author thanks Yu. P. Pushkaraya for setting up the electronic computer program." Orig. art. has: 3 figures, 12 formulas, and 1 table.

ASSOCIATION: None

SUBMITTED: 07Mar64 ENCL: 00 SUB CODE: NP

NR REF SOV: 006 OTHER: 001

Card 2/2

VENEVTSEV, Yu.N.; ZHDANOV, G.S.; SOLOV'YEV, S.P.; BEZUS, Ye.V.; IVANOVA, V.V.; FEDULOV, S.A.; KAPTSHEV, A.G.

Crystallochemical studies of substances with a perovskite-type structure possessing special dielectric properties. Kristallografiia 5 no.4: 620-626 Jl-Ag '60. (MIRA 13:9)

1. Fiziko-khimicheskiy institut im. L. Ya. Karpova.
(Barium titanate) (Lead titanate)

FEDULOV, S.A.; VENEVTSEV, Yu.N.; ZHDANOV, G.S.; SMAZHEVSKAYA, Ye.G.

X-ray and electric investigation of solid solutions in the system $PbTiO_3$ - $SrSnO_3$. Fiz. tver. tela 3 no. 3:959-963 Mr '61. (MIRA 14:5)

(Lead titanate) (Strontium stannate) (Solutions, Solid)

FEDULOV, S.A.; VENEVTSEV, Yu.N.

Structure and dielectric properties of (Pb, Sr) (Ti, Zr)O_3 solid solutions. Fiz.tver.tela 3 no.11:3371-3375 N '61. (MIRA 14:10)

1. Nauchno-issledovatel'skiy fiziko-khimicheskiy institut im. L.Ya.Karpova, Moskva.
(Solutions, Solid)

20646
S/070/61/006/005/004/011
E132/E560

15 2640
24.7200 (1144, 1160)

AUTHORS: Fedulov, S.A., Venevtsev, Yu.N., Zhdanov, G.S. and Rez, I.S.

TITLE: X-ray crystallographic and electrical studies of specimens of the system $PbTiO_3$-$BaZrO_3$

PERIODICAL: Kristallografiya, 1961, Vol.6, No.5, pp.681-685

TEXT: Hitherto the system $PbTiO_3$ - $BaZrO_3$ has hardly been studied. The $PbTiO_3$ synthesized had a tetragonally-distorted perovskite structure with a = 3.899 and c = 4.155 Å giving c/a = 1.065. The $BaZrO_3$ was cubic with a = 4.190 Å These agree with previously published data (Ref.6: H. Megaw, Proc. Phys. Soc., 58, 133, 1946). Fig.1 shows the variation of cell dimensions with composition for intermediate compositions in the continuous series of solid solutions obtained. The volume changes without discontinuity. The two phases appeared to co-exist over the composition range 37.5 to 40% (by weight). At the high $PbTiO_3$ end of the composition range, measurements of the dielectric constant were hindered by the high conductivity. The log of the conductivity was a linear function of 1/T (the absolute temperature). The

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X-ray crystallographic and ... S/070/61/006/005/004/011
E132/E560

dielectric constant was measured at 500 kc for the compositions 20-25% $BaZrO_3$ and at 1 kc otherwise. Fig.4 shows the variation of d.c. with temperature for various compositions of material. The existence of a two-phase region between the ferroelectric (tetragonal) and the paraelectric (cubic) modifications is not new but has been found also in $PbTiO_3$-$BaTiO_3$. This is expressed in the spreading of the maxima in the curves of d.c. against T and corresponds to the statistical distribution of the cations in the two phases. This statistical distribution gives rise to strains in the crystal lattices and as a result the ferroelectric-paraelectric transformation takes place over a finite temperature interval. The rhombohedral phase found by T. Ikeda (Ref.1. J.Phys. Soc. Japan., 14, 2, 168, 1959) was not encountered. The absence of a piezoelectric effect in the range from 40-42.4% also confirms that there was no rhombohedral phase in this case. Work reported by others on the system $PbZrO_3$-$BaTiO_3$ is contradictory.

Acknowledgments are expressed to Ye.G. Smazhevskaya and N. A. Kabalkina for their assistance. There are 6 figures and 11 references, 6 Soviet and 5 non-Soviet The English-language

Card 2/4

references read as follows: Ref.1 (quoted in text); Ref.7:K.Suzuki, J. Phys. Soc. Japan, 6,5,340, 1951; Ref.8: B. Jaffe, R.S.Roth, S. Marzullo, J.Res.Nat.Bur. Standards, 55, 239, 1955; Ref.9: S. Nomura, S. Sawada, J.Phys.Soc. Japan. 10, 2, 1955.

ASSOCATION: Fiziko-khimicheskiy institut imeni L. Ya. Karpova
(Physico-Chemical Institute imeni L. Ya. Karpov)

SUBMITTED: January 20, 1961

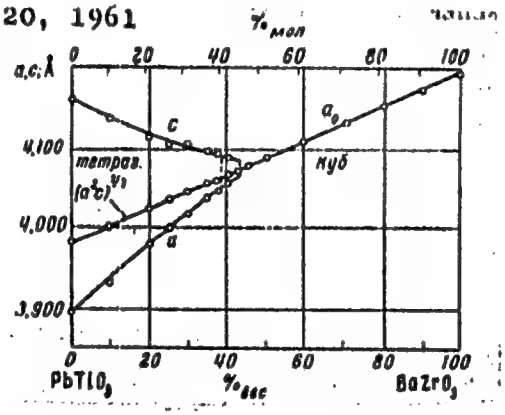

Fig.1.

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26651
S/070/61/006/005/009/011
E032/E114

15 2450
24.7200 (1144, 1160)

AUTHORS: Fedulov, S.A., Venevtsev, Yu.N., Zhdanov, G.S., and Smazhevskaya, Ye.G.

TITLE: High-temperature X-ray and thermographic studies of bismuth ferrite

PERIODICAL: Kristallografiya, 1961, Vol.6, No.5, pp. 795-796

TEXT: In previous papers, Ref.1 (I.S. Rez. Tezisy dokl. Tret'yego soveshchaniya po segnetoelektrichestvu "Abstracts of the Third Conference on Ferroelectrics", Izd-vo AN SSSR, p.51, 1960) and Ref.2 (Yu.N. Venevtsev, G.S. Zhdanov, S.P. Solov'yev, Ye.V. Bezus, V.V. Ivanova, S.A. Fedulov, A.G. Kapyshev, Kristallografiya, Vol.5, 4, 620, 1960) the present authors et al. reported the existence of the compound $BiFeO_3$ with perovskite type structure, and suggested that this compound is a ferroelectric having a higher Curie temperature than lead titanate. The Curie temperature of $BiFeO_3$ and also of the solid solutions belonging to the system $PbTiO_3$-$BiFeO_3$ cannot be determined from dielectric measurements owing to the high conductivity of the specimens. The present authors have therefore carried out high

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High-temperature X-ray and .....

temperature X-ray and thermographic studies of $BiFeO_3$. Specimens were prepared from a mixture of Bi_2O_3 and Fe_2O_3 by heating them to 800 °C for one hour and subsequently repeating this process. The X-ray photographs were obtained with copper radiation and the ВРКД-114 (VRKD-114) camera (designed at the Physicochemical Institute imeni L.Ya. Karpov). The synthesized specimens consisted of a single phase and had a rhombohedral distorted cell of the perovskite type with $a = 3.963$ Å and $\alpha = 89° 24'$. The latter is in agreement with the results reported in Ref.2 (room temperature). Fig.1 shows the variation of a and α with temperature. Analysis of the X-ray photographs obtained led to the conclusion that at 700 °C the $BiFeO_3$ began to decompose and weak lines belonging to a second phase appeared. The decomposition is an irreversible process. The thermographic study was carried out with the aid of the УКТА-58 (UKTA-58) apparatus. Fig.2 shows the thermogram obtained for $BiFeO_3$. It follows from the form of the differential curve (Д), the contraction curve (У) and the weight-loss curve (Б) that up to about 850 °C no phase transformations occur in the specimen. In the temperature ranges

875-930 °C, 970-1030 °C and 1030-1090 °C endothermic effects were observed and there was an appreciable contraction of the specimen which became noticeable immediately after the endothermic effect near 875-930 °C. It is concluded that the Curie temperature of $BiFeO_3$ should be greater than or equal to 850 °C. $BiFeO_3$ can therefore be used as a basis for ferroelectric solid solutions with high Curie temperatures. In addition, this substance will be useful in the development of materials which have both magnetic and ferroelectric properties. Acknowledgments are expressed to V.I. Rivkin and Yu.M. Toropov for assistance in the thermographic studies.
There are 2 figures and 4 Soviet references.

ASSOCIATION: Fiziko-khimicheskiy institut im. L.Ya. Karpova
(Physicochemical Institute imeni L.Ya. Karpov)

SUBMITTED: January 20, 1961

28647
S/020/61/139/006/012/022
B104/B209

15 2640 24.2800 (1063, 1145, 1147)

AUTHOR: Fedulov, S. A.

TITLE: Determination of the Curie temperature of the ferroelectric $BiFeO_3$

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 139, no. 6, 1961, 1345-1346

TEXT: Previous work by the author (Tezisy dokl. III Vsesoyuzn. soveshch. po segentoelektrichestvu (Theses read at the III All-Union Conference on Ferroelectricity), Izd. AN SSSR, 1960, p. 51) and by Yu. N. Venevtsev et al. (Kristallografiya, 5, 4, 620 (1960)) showed that bismuth ferrite has a considerably higher Curie temperature than lead titanate. X-ray analyses showed that bismuth ferrite has rhombohedral perovskite type lattice cells with the parameters a = 3.963 Å and α = 89°24'. Determination of the Curie point of bismuth ferrite and of $(Pb \| Bi)(Ti \| Fe)O_3$ solid solutions in the usual way of dielectric measurement is not possible because of the high electrical conductivity of these materials. The dielectric constant of these materials can be measured only up to 500°C. Up to this temperature, the $\varepsilon(T)$

Card 1/3

curve has no maximum. X-ray studies at higher temperatures showed that a increases with temperature up to 800°C, whereas the angle α remains practically constant. At 700°C, the ferrite begins to disintegrate, and a second crystal phase starts forming. At 800°C the formation of the second crystal phase becomes more intense, but the basic phase is still perovskite type. Therefore, the Curie temperature could not be determined definitely in this manner. More knowledge on the Curie temperature could be gained from the phase diagram of the system $PbTiO_3$-$BiFeO_3$. From the course of the Curie temperature of this system, the Curie temperature of bismuth ferrite was estimated to be 850°C. This high Curie temperature is extremely important in practice (piezoelectric materials etc.). Moreover, it is possible, because of the F_2 ion in $BiFeO_3$, to obtain materials that possess both ferroelectric and magnetic properties. The author thanks Professor G. S. Zhdanov and Yu. N. Venevtsev for their help. There are 2 figures and 6 Soviet references.

ASSOCIATION: Fiziko-khimicheskiy institut im. L. Ya. Karpova (Institute of Physics and Chemistry imeni L. Ya. Karpov)

28647
S/020/61/139/006/012/022
B104/B209

Determination of the Curie ...

PRESENTED: May 17, 1961 by A. V. Shubnikov, Academician

SUBMITTED: April 29, 1961

Card 3/3

S/070/62/007/001/007/022
E132/E460

AUTHORS: Fedulov, S.A., Venevtsev, Yu.N., Zhdanov, G.S., Smazhevskaya, Ye.G., Rez, I.S.

TITLE: X-ray and electrical studies of the system $PbTiO_3$-$BiFeO_3$

PERIODICAL: Kristallografiya, v.7, no.1, 1962, 77-83

TEXT: X-ray powder photographs were taken at various temperatures up to about 800°C of specimens from the $BiFeO_3$-$PbTiO_3$ system and measurements were made of dielectric constant and electrical conductivity. Fig.1 shows the change in cell dimensions with composition, wt.%; Fig.7 shows the phase diagram. The rhombohedral phase near the composition $BiFeO_3$ has an exceptionally high Curie point, about 850°C, which is near its incongruent m.p. At lower concentrations of $BiFeO_3$ (65%) before the transition from tetragonal to rhombohedral, the tetragonal phase reaches a c/a ratio of 1.17, which is exceptionally high. As a base for ferroelectric structure, $BiFeO_3$ has wide possibilities and may lead to technical materials with both ferroelectric and ferromagnetic properties. There are 7 figures.

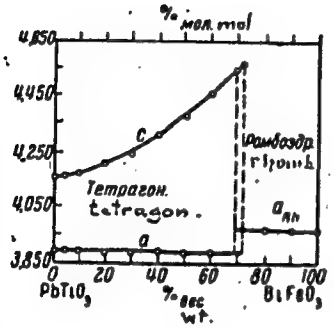
Card 1/2

S/070/62/007/001/007/022
E132/E460

X-ray and electrical studies ...

ASSOCIATION: Fiziko-khimicheskiy institut im. L.Ya.Karpova
(Physicochemical Institute imeni L.Ya.Karpov)

SUBMITTED: June 3, 1961



Card 2/2 Fig.1.

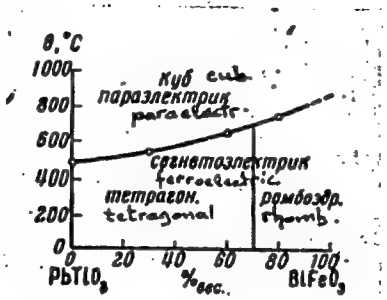


Fig.7.

FEDULOV, S. A.; VENEVTSEV, Yu. N.; DZHMUKHADZE, D. F.

X-Ray diffraction and electric studies of the system $PbTiO_3$- $LaAlO_3$. Kristallografiia 7 no.3:408-411 My-Je '62. (MIRA 16:1)

1. Fiziko-khimicheskiy institut imeni Karpova.

(X-ray crystallography) (Dielectric constant)
(Systems(Chemistry))

24.9700

38380
S/070/62/007/003/009/026
E132/E460

AUTHORS: Fedulov, S.A., Venevtsev, Yu.N., Dzhmukhadze, D.F.

TITLE: X-ray diffraction and electrical studies of the system $PbTiO_3$ - $LaAlO_3$

PERIODICAL: Kristallografiya, v.7, no.6, 1962, 408-411

TEXT: $PbTiO_3$ being ferroelectric and $LaAlO_3$ paraelectric, the pseudo-binary system is of interest. Pure $PbCO_3$, Al_2O_3, TiO_2 and La_2O_3 were used to make the materials, sintering being carried out at 800 to 1200°C and again at 1100 to 1400°C in each case for 1 hour. High precision X-ray powder photographs were taken of the products. The dielectric constant ε and the loss tan δ were measured at 1 Kc/s on a bridge. The phase diagram is as shown in Fig.1. The cubic region widens with increasing temperature until at 500°C there is only a cubic phase at all compositions. The temperature dependence of ε was measured with increasing content of $LaAlO_3$. A significant drop in the peak height takes place and the position of the maximum passes below 0°C for contents greater than 20%. A significant piezoelectric effect was found for specimens containing 5 and 7.5% $LaAlO_3$. The

Card 1/2

S/070/62/007/003/009/026
E132/E460

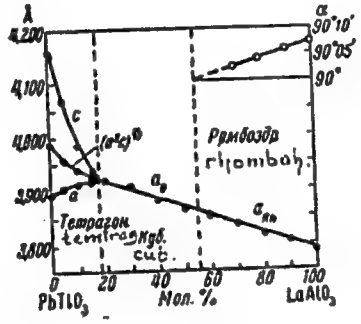
X-ray diffraction and ...

combination of high piezoelectricity and high Curie temperature (above 300°C) may be technically useful. Professor G.S.Zhdanov is thanked for his advice. There are 5 figures.

ASSOCIATION: Fiziko-khimicheskiy institut im. L.Ya.Karpova
(Physicochemical Institute imeni L.Ya.Karpov)

SUBMITTED: July 10, 1961

Fig.1.



Card 2/2

24.7800 (1035, 1043, 1153)

35598
S/048/62/026/003/007/015
B117/B102

AUTHORS: Fedulov, S. A., Venevtsev, Yu. N., Zhdanov, G. S., and Dzhmukhadze, D. F.

TITLE: X-ray and electrical analysis of the system $PbTiO_3$-$LaFeO_3$

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya fizicheskaya, v. 26, no. 3, 1962, 357 - 361

TEXT: This paper was presented at the VII Nauchno-tekhnicheskoye soveshchaniye po primeneniyu rentgenovykh luchey k issledovaniyu materialov (7th Scientific-technical Conference on the Use of X-rays for the Examination of Materials) held in Leningrad from June 22 to 29, 1961. The system $PbTiO_3$ - $LaFeO_3$ was studied by means of X-ray and electrical analysis. The specimens were prepared by double annealing (preliminary annealing at 800 - 1100°C, final annealing at 1100 - 1400°C, for one hour each) in lead oxide vapor. X-ray analysis was made with CuK_α and FeK_α radiation in РКУ-114 (RKU-114) and РКД-143 (RKD-143) cameras (designed at the Fiziko-khimicheskiy institut im. L. Ya. Karpova (Physicochemical

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Institute imeni L. Ya. Karpov). The dielectric constant was measured at 450 kcps by a KV-1 (KV-1) Q-meter, electrical conductivity was measured by a MOM-4 (MOM-4) bridge. The results obtained by X-ray analysis agree with those in other publications. The system $PbTiO_3$ - $LaFeO_3$ forms a continuous series of solid solutions which at room temperature occur in three modifications: tetragonal, pseudomonoclinic I, and pseudomonoclinic II. Specimens with an $LaFeO_3$ content higher than 50% showed a hyperfine structure of the lines whose intensities increased with the $LaFeO_3$ concentration. The elementary cell volume of solid solutions $(Pb,La)(Ti,Fe)O_3$ decreased with increasing $LaFeO_3$ concentration. This became especially distinct in the region of tetragonal modification and can be explained by the specific electrostrictive properties of $PbTiO_3$. According to the activation energy determined for $PbTiO_3$ and $LaFeO_3$ from their conductivities (with relatively high values), these compounds were classified as semiconductors. The temperature dependences of conductivity of solid solutions as functions $\log \sigma = f(1/T)$ had a complicated course when the $LaFeO_3$

content was increased. This indicates a change in the conductivity mechanism of solid solutions according to their composition. At certain temperatures, corresponding to the phase transition points, salient points were observed on these straight lines. A phase diagram (Fig. 5) was set up on the basis of the data obtained. Comparison of the data obtained for $PbTiO_3$ - $LaFeO_3$ with those for $PbTiO_3$ - $BiFeO_3$ showed that in contrast to $PbTiO_3$ - $BiFeO_3$ in which the Curie temperature rises when $BiFeO_3$ is added, the Curie temperature decreases in $PbTiO_3$ - $LaFeO_3$ when the $LaFeO_3$ concentration is increased. Probably the main reason thereof is the different polarizability of the La and Bi ions compared with the polarizability of the Pb ion. The different ionic radii of Bi (1.20 Å) and La (1.04 Å) probably do not influence the behavior of the Curie temperature. Presumably they are the main reason of the different sequence of the phases. The relatively high temperature of the magnetic transformation of $LaFeO_3$ ($\sim 570^{\circ}C$) in part of the solid solutions in its neighborhood also suggest magnetic properties. The authors thank Ye. G. Smazhevskaya for her help. There are 5 figures and 13 references: 8 Soviet and 5 non-Soviet.
Card 3/5

X-ray and electrical analysis...

The four references to English-language publications read as follows: N. D. Megaw, Proc. Phys. Soc., 58, 133 (1946); R. Roy, J. Res. Nat. Bur. Standards, 58, 2, 75 (1957); M. H. Francombe, B. Lewis, J. Electronics, 2, 387 (1957); G. Shirane, S. Hoshino, K. Suzuku, Phys. Rev., 80, 6, 1115 (1950).

ASSOCIATION: Fiziko-khimicheskiy institut im. L. Ya. Karpova (Physico-chemical Institute imeni L. Ya. Karpov)

Fig. 5. Phase diagram of the system $PbTiO_3$ - $LaFeO_3$.

Legend: (1) cubic (paraelectric); (2) tetragonal (piezoelectric); (3) pseudomonoclinic I; (4) pseudomonoclinic II.

Card 4/5

VENEVTSEV, Yu. N.; ZHDANOV, G. S.; ROGINSKAYA, Yu. Ye.; FEDULOV, S. A.; IVANOVA, V. V.

"Investigation of some solid solutions based on the ferroelectric-antiferromagnetic $BiFeO_3$."

report submitted for 6th Gen Assembly, Intl Union of Crystallography, Rome, 9 Sep 63.

Karpov Inst of Physical Chemistry, Moscow.

FEDULOV, S. A.

"Investigation of some solid solutions based on the ferroelectric-antiferromagnetic FiFeO."

report presented at the Symposium on Phase Transitions in Solids, 6th General Assembly, Intl. Union of Crystallography, Rome, Italy, 16-18 Sep 1963.

(Karpov Institute of Physical Chemistry, Moscow, USSR)

L 10630-63 EWP(q)/EWT(m)/BDS--AFFTC/ASD--JD

ACCESSION NR: AP3000781 S/0070/63/008/003/0454/0456

57
56

AUTHOR: Fedulov, S. A.; Venevtsev, Yu. N.

TITLE: On the problem of the transition region between the ferro- and paraelectric phases of (Pb, Ba)(Ti, Zr) O_3 solid solutions

SOURCE: Kristallografiya, v. 8, no. 3, 1963, 454-456

TOPIC TAGS: lead titanate, barium zirconate, solid solution, x-ray diffraction, two-phase region, VRKD-114 chamber, phase composition, dielectric constant, lattice parameter, ferroelectric state, paraelectric state, phase diagram

ABSTRACT: The presence at room temperature of a two-phase region between the ferroelectric (tetragonal) and paraelectric (cubic) phases of solid solutions of the system $PbTiO_3$-$BaZrO_3$ is indicated by indistinct dielectric-constant maxima on the $\varepsilon = f(T)$ curves. This fact and a continuous drop in the Curie temperature with an increase of the $BaTiO_3$ content indicates that the two-phase region exists in a wide temperature range. The width of this region and the phase composition of individual specimens were studied at temperatures up to 300C by the

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L 10630-63
ACCESSION NR: AP3000781

X-ray diffraction method on specimens containing 40% $PbTiO_3$ and 60% $BaZrO_3$; a VRKD-114 chamber was used. The lattice constants were calculated and lattice-constant—temperature curves were plotted. These plots indicate that the transition region from the para- to the ferroelectric state begins at approximately 175C and that with an increase in temperature tetragonal-phase content drops while cubic-phase content increases. A section of the phase diagram of the system $PbTiO_3$-$BaZrO_3$ with a tentative plot of the two-phase region is given. The plot shows that the temperature range in which this region is present is widened by an increase in $BaZrO_3$ content and reaches 175C for a $BaZrO_3$ content of 40%. Orig. art. has: 2 figures.

ASSOCIATION: Fiziko-khimicheskiy institut im. L. Ya. Karpova (Physicochemical Institute)

SUBMITTED: 05Jan62 DATE ACQ: 21Jun63 ENCL: 00

SUB CODE: CH NO REF SOV: 009 OTHER: 003

ch/ks
Card 2/2

L 14282-63 EWT(1)/EWP(q)/EWT(m)/BDS/EEC(b)-2/ES(s)-2 AFFTC/ASD/ESD-3/
SSD Pt-4 GG/JD/HW-2/IJP(C)
ACCESSION NR: AP3004098 S/0070/63/008/004/0610/0616 86 77

AUTHOR: Roginskaya, Yu. Ye.; Venevtsev, Yu. N.; Fedulov, S. A.; Zhdanov, G. S.

TITLE: X-ray investigation and study of magnetic and electrical properties of the $BiFeO_3$-$LaFeO_3$ system

SOURCE: Kristallografiya, v. 8, no. 4, 1963, 610-616

TOPIC TAGS: ferromagnet, antiferromagnet, weak ferromagnet, ferroelectric, antiferroelectric, bismuth orthoferrite, bismuth ferrate (III), lanthanum orthoferrite, lanthanum ferrate (III), lead zirconate, bismuth orthoferrite-lanthanum orthoferrite system, lead titanate-lanthanum orthoferrite system, bismuth orthoferrite-lanthanum aluminate system, solid solution, distorted perovskite structure

ABSTRACT: The $BiFeO_3$-$LaFeO_3$ system of solid solutions has been studied in order to establish the mechanism controlling the properties of compounds such as $BiFeO_3$, which possess ferroelectric properties combined with antiferromagnetic properties. Samples of $BiFeO_3$-$LaFeO_3$ were prepared from reagent-grade Bi_2O_3, La_2O_3, and Fe_2O_3 and were fired first at 800—1000C for 1.5 hr and then at 850—1300C for 1.5 hr. X-ray photographs were taken with an RKU-114 camera and FeK_α x-ray. The unit-cell

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parameters were determined by a method previously described (Zavodsk. laboratoriya, 27, 1113, 1961). The x-ray phase analysis revealed the existence of a continuous solid solution over the entire composition range. Plots of the parameters versus $LaFeO_3$ content in the sample indicated four crystalline modifications of the solid solution: one rhombohedral, in the 0—18.8 mol% $LaFeO_3$ range, and three pseudomonoclinic, PM I, PM II, and PM III, in the 18.8—55, 55—73, and 73—100 mol% $LaFeO_3$ ranges, respectively. When $LaFeO_3$ content is increased, a sharp discontinuity in the parameters is noted on transitions between modifications, together with a decrease in volume of the unit-cell. Weak superstructural lines on x-ray diagrams of the PM I samples show the similarity of this structure to that of $PbZrO_3$, which is antiferroelectric. Magnetic measurements were carried out by the Faraday method with equipment developed by NIFKhI. The similarity between the curves of magnetization versus temperature in the 0—600C range, and the presence of spontaneous magnetization (σ_o) at room temperature over the entire composition range made it possible to conclude that all samples were antiferromagnetic. The evolution of σ_o with the composition may be seen from Fig. 1 of the Enclosure. The dielectric constant (ε) was measured with an MPP-300 bridge, and the temperature dependence of conductivity, with a VOLU-1,

voltmeter.[10] The maximum conductivity was found in samples with 40 and 50% $LaFeO_3$. One of the two breaks on each of the curves of conductivity versus temperature coincided with the Neel temperature (T_N). The peaks on the curves of ε versus temperature, together with the x-ray data, establish the anomalous dielectric properties of samples in the 25—45% $LaFeO_3$ range. The ε of samples with more than 45% $LaFeO_3$ increases continuously with increasing temperature. It is concluded that the rhombohedral modification (with less than 18.8 mol% $LaFeO_3$) is ferroelectric because of the presence of peaks on the ε versus t curves in the rhombohedral region of the $BiFeO_3$-$LaFeO_3$ system, although the peaks were absent in that region in the system studied. The phase diagram of the system, shown in Fig. 1, was established on the basis of all the data considered. The T_c line represents the ferroelectric Curie points and the T_N line, the Neel temperature. Two regions of the diagram are of particular interest, that of compositions up to 18.8 mol% $LaFeO_3$, which combine ferroelectric with antiferromagnetic properties, and that of compositions in the 18.8—55 mol% $LaFeO_3$ range, which combine antiferroelectric with weak ferromagnetic properties. Coincidence of the transition between the two regions with the discontinuity of σ_0 is considered proof of a definite interconnection between the special electrical and magnetic properties

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ACCESSION NR: AP3004098

4

of a given solid solution. Both properties are dependent upon the same factor, the atomic configuration. "The authors express thanks to A. S. Borovik-Romanov, N. M. Kreynes, and V. I. Smirnova for their valuable advice and remarks." Orig. art. has: 5 figures.

ASSOCIATION: Nauchno-issledovatel'skiy fiziko-khimicheskiy institut im. L. Ya. Karpova (Scientific Research Physicochemical Institute)

SUBMITTED: 29Jan63 DATE ACQ: 15Aug63 ENCL: 01

SUB CODE: PH NO REF SOV: 018 OTHER: 007

Card 4/84

ACCESSION NR: AP4011779 S/0181/64/006/001/0316/0317

AUTHORS: Shapiro, Z. I.; Fedulov, S. A.; Venevtsev, Yu. N.

TITLE: Curie point of ferroelectric lithium tantalate

SOURCE: Fizika tverdogo tela, v. 6, no. 1, 1964, 316-317

TOPIC TAGS: ferroelectric lithium tantalate, Curie point, dielectric property, lithium carbonate, tantalum pentoxide, lattice parameter, hexagonal axis, rhombohedral axis, dielectric permeability, bridge MPP-300, piezoelectric effect

ABSTRACT: An attempt was made to determine the dielectric properties in ceramic specimens of lithium tantalate across a broad temperature range. Experimental specimens were produced from lithium carbonate and tantalum pentoxide. They were purified by two repeated heatings (60 min each), one at 1100C and one at 1350C. X-ray analysis and subsequent calculations proved that the lattice parameters of lithium tantalate were: on hexagonal axes -- $a_H = 5.153$ Å and $c_H = 13.775$ Å; on rhombohedral axes -- $a_{Rh} = 5.470$ Å and $\alpha_{Rh} = 56^\circ12'$. Dielectric permeabilities

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ACCESSION NR: AP4011779

were measured with a bridge MPP-300 at the frequency of 250 kiloherts. The curve of $\epsilon = f(T)$ showed a sharp maximum at the temperature of about 665C. Dielectric permeability at room temperature was 70, at the maximum it reached 1850. Above the Curie point the change in the dielectric permeability was calculated from the Curie-Weiss law. The specimens showed a weak piezoelectric effect. These results disprove the claim made by H. D. Megave (Acta Cryst., 7, 191, 1954; "Ferroelectricity in crystals," p. 103, London, 1957), to the effect that lithium tantalate forms simple pyroelectrical crystals. At the present time the authors are undertaking a study of properties exhibited by $LiTaO_3$ and $LiNbO_3$ and also of solid solutions based on these substances. Orig. art. has: 1 formula and 1 diagram.

ASSOCIATION: Vsesoyuzny*y nauchno-issledovatel'skiy institut khimicheskikh reaktivov i osobo chisty*kh khimicheskikh veshchestv, Moscow (All-Union Scientific Research Institute of Chemical Reactions and of Pure Chemical Materials)

SUBMITTED: 12Aug63 DATE ACQ: 14Feb64 ENCL: 00

SUB CODE: CH, PH NO REF SOV: 000 OTHER: 002

Card 2/2

ACCESSION NO: AP4013507 S/0181/64/006/002/0475/0478

AUTHORS: Fedulov, S. A.; Lady*zhinskiy, P. B.; Pyatigorskaya, L. I.; Venevtsev, Yu. N.

TITLE: Complete phase diagram of the system $PbTiO_3$ $BiFeO_3$

SOURCE: Fizika tverdogo tela, v. 6, no. 2, 1964, 475-478

TOPIC TAGS: phase diagram, PbTiO sub 3, BiFeO sub 3, piezoelectric, phase transition, Curie point, morphotropic phase transition, polarization, ferroelectric, ferromagnetic, Neel temperature, conductivity

ABSTRACT: Using x-ray investigations and electrical and magnetic measurements, the authors have constructed a complete phase diagram of the system $PbTiO_3$-$BiFeO_3$. This diagram is shown in Fig. 1 on the Enclosure. It is seen that in the region of the morphotropic phase transition the Curie point is very high (on the order of 700C), and it therefore seems suitable (in order to obtain high-temperature piezoelectric material) to introduce other material into the system to decrease the conductivity and to improve the conditions of polarization. The authors suggest, from this point of view, studies of the three-component systems $PbTiO_3$-$BiFeO_3$-$PbZrO_3$ and $PbTiO_3$-$BiFeO_3$-$LaAlO_3$. "The authors consider it their duty to express

Card 1/2

ACCESSION NO: AP4013507

thanks to Yu. Ye. Roginskaya for her aid in the work." Orig. art. has: 5 figures.

ASSOCIATION: Vsesoyuzny*y nauchno-issledovatel'skiy institut khimicheskikh reaktivov i osobo chisty*kh khimicheskikh veshchestv, Moscow (All-Union Scientific Research Institute of Chemical Reagents and Extra Pure Chemical Substances)

SUBMITTED: 12Aug62 DATE ACQ: 03Mar64 ENCL: 01

SUB CODE: PH NO REF SOV: 009 OTHER: 001

Card 2/2

ACCESSION NR: AP4039396 S/0070/64/009/003/0358/0362

AUTHORS: Fedulov, S. A.; Venevtsev, Yu. N.

TITLE: Investigating the system $PbTiO_3$-$CaSnO_3$ and $PbTiO_3$-$CaZrO_3$

SOURCE: Kristallografiya, v. 9, no. 3, 1964, 358-362

TOPIC TAGS: ceramic technology, x ray analysis, electric property/ RKU 114 x ray camera, RKD 143 x ray camera

ABSTRACT: Samples of the indicated systems were prepared by ordinary ceramic technology. X-ray analyses were made with CuK_α, FeK_α, and CrK_α radiation in RKU-114 and RKD-143 cameras. The results show a continuous series of solid solutions in the $PbTiO_3$-$CaSnO_3$ system. The solid solutions form at room temperature in three modifications: tetragonal I, tetragonal II, and pseudomonoclinic. In the field of tetragonal I, the lattice constant c decreases sharply and a increases with increase in $CaSnO_3$ content. When the $CaSnO_3$ content reaches ~22% (by weight), the tetragonal II field is reached. With further increase in $CaSnO_3$ content, the change in c is negligible, but a diminishes appreciably. At ~55% $CaSnO_3$ the

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ACCESSION NR: AP4039396

pseudomonoclinic field is reached. Here a = c and the two increase slightly with increase in $CaSnO_3$, but b remains almost unchanged. The $PbTiO_3$-$CaZrO_3$ system displays no continuous series of solid solutions. Here there is a broad two-phase region consisting of two perovskite modifications. The dielectric constant shows a sharp maximum for each system when the concentration of the second constituent (stannate or zirconate) is 20% or less. The absolute value is higher for $PbTiO_3$-$CaZrO_3$ (~ 3000) than for $PbTiO_3$-$CaSnO_3$ (~2000). In both systems the values decrease appreciably with increase in content of the second constituent. Conductivity and dielectric loss diminish markedly with increase in these second constituents. The decrease in conductivity was found to be on the order of a thousandfold for a content of 15% $CaSnO_3$ over pure $PbTiO_3$ at 100C. The authors conclude that no anomalous effects were noted that might be associated with transitions of "crumpling." The authors thank Professor G. S. Zhdanov for his interest in the work and his discussions of the results. Orig. art. has: 3 figures.

ASSOCIATION: Vsesoyuzny*y nauchno-issledovatel'skiy institut khimicheskikh reaktivov (All Union Scientific Research Institute of Chemical Reagents)

Card 2/3

ACCESSION NR: AP4039396

SUBMITTED: 25Sep63 ENCL: 00

SUB CODE: SS, EC, MT NO REF SOV: 004 OTHER: 005

Card 3/3

ACCESSION NR: AP4043189 S/0070/64/009/004/0516/0520

AUTHORS: Fedulov, S. A.; Lady*zhenskiy, P. B.; Venevtsev, Yu. N.

TITLE: Investigation of the system $BiFeO_3$-$LaAlO_3$

SOURCE: Kristallografiya, v. 9, no. 4, 1964, 516-520

TOPIC TAGS: bismuth inorganic compound, lanthanum compound, ferroelectric property, perovskite structure, solid solution, dielectric constant

ABSTRACT: Both investigated compounds have a perovskite structure and were expected to form solid solutions. It was also assumed that addition of $LaAlO_3$ to $BiFeO_3$ would lead to a decrease of the conductivity which would facilitate the study of the temperature dependence of the dielectric constant in a wide range of temperatures. It was assumed that the results of these measurements would further confirm the presence of ferroelectric properties in bismuth ferrite. The in-

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ACCESSION NR: AP4043189

vestigation of the system was also aimed at studying the effect of various factors on the magnetic properties of similar compounds, and to determine regions in which they possess special dielectric and magnetic properties. The starting materials were Bi_2O_3, Fe_2O_3, Al_2O_3 (analytical purity), and La_2O_3 (technical purity). The x-ray analysis was carried out with CuKα and CoKα radiation. The lattice parameters were determined to within 0.0015 Å, the volume to within 0.07 $Å^3$, and the angle to within 2'. The magnetic measurements were carried out by a method described in Kristallografiya v. 8, no. 4, p. 610, 1963. X-ray analysis of samples with intermediate compositions showed that one-phase perovskite solid solutions occurred only up to 37.5 mole % $LaAlO_3$. Samples with 25--35 mole % $LaAlO_3$ exhibit the clear maxima of the dielectric constant typical of ferroelectrics. With increasing $LaAlO_3$ content the maxima shift towards lower temperatures. The temperature dependence of the specific magnetization for samples of the homogeneous region was obtained at H = 7600 Oe.

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ACCESSION NR: AP4043189

All solid solutions were found to be antiferromagnetic with weak ferromagnetism. For samples with 35 mole % $LaAlO_3$ the specific spontaneous magnetization reaches 0.15. The Curie temperature of $BiFeO_3$ is estimated by extrapolation to be about 850°C. The data make it possible to construct a part of the phase diagram of the system $BiFeO_3$--$LaAlO_3$ on the side of $BiFeO_3$ (Encl. 01). The decrease of the ferroelectric Curie temperature with increasing $LaAlO_3$ content is due, in the opinion of the authors, to the considerably weaker electron polarizability of the Li^{3+} ion compared with that of Bi^{3+}. Most interesting is the rather strong increase of the Neel temperature on the introduction of $LaAlO_3$. This is due mainly to the somewhat smaller lattice constant of $LaAlO_3$. "The authors thank Prof. G. S. Zhdanov and Yu. E. Roginskaya for valuable advice and remarks."
Orig. art. has: 7 figures.

Card 3/5

ACCESSION NR: AP4043189

ASSOCIATION: VNII khimicheskikh reaktivov i osobo chisty*kh veshchestv Fiziko-khimicheskiy institut im. L. Ya. Karpova (All-Union Institute of Chemical Reagents and Ultrapure Materials, Physico-chemical Institute)

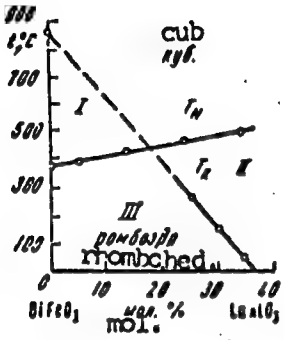
SUBMITTED: 25Sep63 ENCL: 01

SUB CODE: SS NR REF SOV: 014 OTHER: 002

Card 4/5

ACCESSION NR: AP4043189

ENCLOSURE: 01



Part of the phase diagram of the $BiFeO_3$-$LaAlO_3$ system on the $BiFeO_3$ side.

T_K - ferroelectric Curie temperature, T_N - antiferromagnetic Neel temperature
I - ferroelectric region
II - region of weak ferromagnetism
II - region with combined properties

Card 5/5

ACCESSION NR: AP4030644 S/0048/64/028/004/0683/0690

AUTHOR: Venovtsev, Yu.N.; Zhdanov, G.S.; Roginskaya, Yu.Ye.; Fedulov, S.A.; Ivanova, V.V.; Chkalova, V.V.; Viskov, A.S.; Kapy*shev, A.G.; Bondarenko, V.S.; Lady*zhinskiy, P.B.

TITLE: Investigation of some solid solutions based on the ferroelectric-ferromagnet bismuth ferrite /Report, Symposium on Ferromagnetism and Ferroelectricity held in Leningrad 30 May to 5 June 1963/

SOURCE: AN SSSR. Izv. Ser.fiz., v.28, no.4, 1964, 683-690

TOPIC TAGS: ferromagnetism, ferroelectricity, bismuth ferrite, bismuth ferrite solid solution

ABSTRACT: By investigating solid solutions of $Bi_2O_3 \cdot Fe_2O_3$ in $PbTiO_3$, some of the authors, together with others, were able to show the existence of the compound $BiFeO_3$ with the perovskite structure and strong ferroelectric properties. This work is reviewed, and later investigations are reported of the electric and magnetic properties of solid solutions containing $BiFeO_3$. The solutions discussed are the two-component systems in which one component is $BiFeO_3$ and the other is $LaFeO_3$, $LaCrO_3$,

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$PbTiO_3$, $BaTiO_3$, $PbZrO_3$, $LaAlO_3$, or $SrSnO_3$. Of these solutes, two are ferromagnetic, two are ferroelectric, one is antiferroelectric and two are perovskites with normal magnetic and electric properties. Phase diagrams are given for the $PbTiO_3$, $LaCrO_3$, and $BaTiO_3$ solutions. Curves of magnetization versus temperature are given for various compositions of the $LaCrO_3$ and $PbZrO_3$ solutions, and curves of dielectric constant versus temperature for the $LaAlO_3$, $PbZrO_3$ and $BaTiO_3$ solutions. The Neel point is plotted against composition for all the solutions except those containing $SrSnO_3$, which could not be obtained as a single phase. Extrapolation of the Curie points of the $LaAlO_3$ and $PbZrO_3$ solutions to zero concentration confirmed the high ferroelectric Curie point (about 850°C) of $BiFeO_3$. The weak ferromagnetic properties of $BiFeO_3$ persisted in solutions containing high concentrations of materials without peculiar magnetic properties. Particularly interesting is the concentration dependence of the spontaneous magnetization of the $LaCrO_3$ solutions; the magnetization increased discontinuously as the system crossed the boundary from the ferroelectric to the antiferroelectric state. The $LaFeO_3$ solutions are said to have behaved similarly, but as these solutions have been discussed in detail elsewhere (Yu.B.Roginskaya, Yu. N.Venevtsev, G.S.Zhdanov and S.A.Fedulov, Kristallografiya,8,1963), the data are not given. An anomaly in the Mossbauer spectrum of the $SrSnO_3$ solutions that was pre-

ACCESSION NR: AP4030644

viously ascribed to a ferroelectric transition (Fam Zui Khiyen, A.S.Viskov, V.C. Shpinel' and Yu.N.Venevtsev, Zhur.eksp.i teor.fiz.,44,1963) is now believed to be due to antiferromagnetic ordering. Orig.art.has: 10 figures.

ASSOCIATION: none

SUBMITTED: 00 DATE ACQ: 30Apr64 ENCL: 00

SUB CODE: EM NR REF SOV: 016 OTHER: 006

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FEDULOV, S.A.; LADYZHENSKIY, P.B.; VENEVTSEV, Yu.N.

Study of the system $BiFeO_3$--$LaAlO_3$. Kristallografiia 9 no.4: 516-520 Jl-Ag '64. (MIRA 17:11)

1. Vsesoyuznyy nauchno-issledovatel'skiy institut khimicheskikh reaktivov i osobo chistykh veshchestv i Fiziko-khimicheskiy institut imeni Karpova.

ACCESSION NR: AP5008477 UR/0070/65/010 002/0268/0270 53 46 B

AUTHOR: Fedulov, S. A.; Shapiro, Z. I.; Ladyzhinskiy, P. B.

TITLE: Application of the Czochralski technique in growing $LiNbO_3$, $LiTaO_3$, and $NaNbO_3$ single crystals

SOURCE: Kristallografiya, v. 10, no. 2, 1965, 268-270

TOPIC TAGS: crystal, piezoelectric crystal, potassium compound, niobate, tantalum compound, alkali metal, ferroelectricity, crystallization

ABSTRACT: Previously reported Soviet sources have described research on growing large piezoelectric single crystals of potassium niobate and potassium tantalate using the technique of spontaneous or oriented (seed) crystallization from a fluxed melt.

In the most recent Soviet publication, the subject has been enlarged to include all niobates and tantalates of alkaline metals, using the Czochralski technique to grow single crystals of these compounds. However, the emphasis was put on metaniobate and metatantalate of lithium, the properties of which are relatively unknown as compared to those of corresponding

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sodium and potassium compounds. The work was motivated by the previously detected ferroelectric property in ceramic samples of $LiTaO_3$ [2] and some preliminary indications that $LiNbO_3$ may be pyroelectric (the "frozen ferroelectric" of Megaw).

Such materials in single crystalline form are known to display an electro-optic effect which makes their application very promising in optical shutters or modulators at uhf (at least 10^4 Mc/sec) [3]. The stated purpose of the work was to produce large flawless crystals by the Czochralski technique, which was considered more advantageous than the previously used techniques.

Crystal growth experiments were carried out in universal VTsP crystallization apparatus which was designed by the Special Design Office of the Institute of Crystallography, Academy of Sciences USSR. The powdered charge was induction heated in platinum or platinum-rhodium crucibles to a temperature 50—70° C above the melting point of the corresponding compound. The crystals were grown in air at pulling speeds of 11—25 mm/hr. Crystal orientation was obtained by self-nucleation of the melt on a platinum wire acting as a seed. All crystals were annealed at 1050—1300° C.

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The single crystals of the following materials were obtained by using the Czochralski technique: $LiNbO_3$ (mp = 1170° C), maximum size of 10 x 50—60 mm, transparent or yellowish (after annealing), oriented in the [0001] direction; $LiTaO_3$ (mp = 1560° C), intensely yellow-green, dimensions unspecified, prepared with some difficulty because of a relatively high melting point; and $NaNbO_3$ (mp = 1350° C), maximum size of 10 x 50 mm, grown with extreme difficulty because of strain which produces cracks. The strain is due to five phase transitions between 640°C and room temperature.

Attempts to grow $NaTaO_3$, $KTaO_3$, and $KNbO_3$ single crystals by the Czochralski technique failed because of the high melting point (over 1650° C) of $NaTaO_3$ or incongruent melting of the potassium compounds. The most suitable growth techniques for large single crystals of the potassium compounds are believed to be either crystallization from fluxed melts, with seeding as described by C. E. Miller [4] or hydrothermal growth. The $NaTaO_3$ single crystals might be grown by the Czochralski technique but in crucibles made of more refractory metals or alloys.

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Only samples of rubidium and cesium niobates and tantalates were prepared by the usual ceramic technology to establish their crystal structure. The x-ray study of the samples indicated a structure different from perovskite for these compounds. This finding seems to contradict a previous Soviet source which attributed perovskite structure to $RbNbO_3$ and $RbTaO_3$.

The Karpov Physicochemical Institute and the All-Union Scientific Research Institute of Chemical Reagents and High-purity Substances were given as the authors' affiliation.

In a post-scriptum, the authors pointed out recent American sources, which reported a large electro-optic effect in single crystals of $K(Ta,Nb)O_3$ solid solutions,[4] and in $LiNbO_3$ and $LiTaO_3$[5] crystals grown by the Czochralski technique.[6]

COMMENT: The technique used by the authors to produce single crystals of $LiNbO_3$ and $LiTaO_3$ closely resembles the one more recently described by A. A. Ballman. However, the crystals produced by the Soviet authors, according to the descriptions given, seem to be somewhat inferior in respect to color and dimensions. The authors of the Soviet article erroneously

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quoted American sources as having reported an electro-optic effect in $LiTaO_3$ single crystals. In fact, both American sources report no significant effect at direct current or 21 Mc/sec in the material produced by the Czochralski technique. Orig. art. has 3 figures and 1 table.

[1] FSB, v. 1, no. 1, 1965, 30-32.

[2] Shapiro, Z. I., S. A. Fedulov, and Yu. N. Venevtsev. Curie point of the ferroelectric $LiTaO_3$. Fizika tverdogo tela, v. 6, no. 1, 1964, 316-317.

[3] Vaynshteyn, B. K. Present-day problems of crystallography. IN: Akademiya nauk SSSR. Vestnik, no. 6, 1963, 31-38.

[4] Journal of Applied Physics, v. 29, no. 2, 1958, 233-234.

[5] Geusic, J. E., S. K. Kurtz, L. G. Van Uitert, and S. H. Wemple. Applied Physics Letters, v. 4, no. 8, 1964, 141-143.

[6] Peterson, G. E., A. A. Ballman, P. V. Lenzo, and P. M. Bridenbaugh. Applied Physics Letters, v. 5, no. 3, 1964, 62-64.

[7] Ballman, A. A. Journal of the American Ceramic Society, v. 48, no. 2, 1965, 112-113

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L 49052-65

ACCESSION NR: AP5008477 O

ASSOCIATION: Fiziko-khimicheskiy Institutit im. Karpova (Physico-Chemical Institute)

SUBMITTED: 08Jun64 ENCL: 00 SUB CODE: SS, IC

NO REF SOV: 008 OTHER: 008 FSB, v. 1, no. 6

Card 6/6 mb

L 59496-65 EFF(c)/EPR/EWG(j)/EWA(c)/EWT(m)/EWP(b)/T/EWP(t) Pr-4/Pu-4 LIP(c)
ACCESSION NR: AP5013710 JD UR/0070/65/010/003/0291/0296
548.736

38
36
3

AUTHOR: Fedulov, S. A.; Pyatigorskaya, L. I.; Venevtsev, Yu. N.

TITLE: Investigation of the $BiFeO_3$-$SrTiO_3$ system

SOURCE: Kristallografiya, v. 10, no. 3, 1965, 291-296

TOPIC TAGS: binary phase diagram, solid solution, alloy, relaxation process, x ray analysis

ABSTRACT: X-ray analysis was used to study the dielectric and magnetic properties of solid solutions in the $BiFeO_3$-$SrTiO_3$ system. The phase diagram of the solid state was constructed from data obtained in the investigations. According to the experimental results, the system has a series of rather interesting regions of solid solutions (see fig. 1 of the Enclosure). Region I (cubic modification I) is characterized by its transition from the paraelectric state into a state of relaxation polarization when the $BiFeO_3$ content is increased. This relaxation polarization is retained in the next region of solid solutions II (the region of cubic modification II). However, the relaxation maxima take place at approximately the

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2

same temperatures. When the $BiFeO_3$ content is greater than 60%, cubic modification II, which has relaxation polarization, is transformed into a rhombohedral modification in which ferroelectric properties are combined with weak ferromagnetic properties. Because the conductivity of samples increases with $BiFeO_3$ content, the maximum on the curve $\varepsilon = f(T)$ could be detected only for the sample with 60% $BiFeO_3$. The Curie point of this sample is approximately 330°C. From X-ray data it can be concluded that the Curie temperature of the samples increases with $BiFeO_3$ content. From data presented elsewhere concerning the polarization of $SrTiO_3$-$Bi_2O_3 \cdot 3TiO_2$ solid solutions, it can be assumed that relaxation polarization which takes place in cubic modification II changes to spontaneous polarization of the rhombohedral modification when the $BiFeO_3$ content is approximately 59%. "The authors express sincere gratitude to V. M. Petrov for discussing the results of the work." Orig. art. has: 5 figures.

ASSOCIATION: Fiziko-khimicheskiy institut im. L. Ya. Karpova (Physicochemical Institute)

SUBMITTED: 05Aug65 ENCL: 01 SUB CODE: SS, EM

NO REF SOV: 008 OTHER: 005

APPROVED FOR RELEASE: Monday, July 31, 2000 CIA-RDP86-00513R000412810

L 59496-65
ACCESSION NR: AP5013710 ENCLOSURE: 01

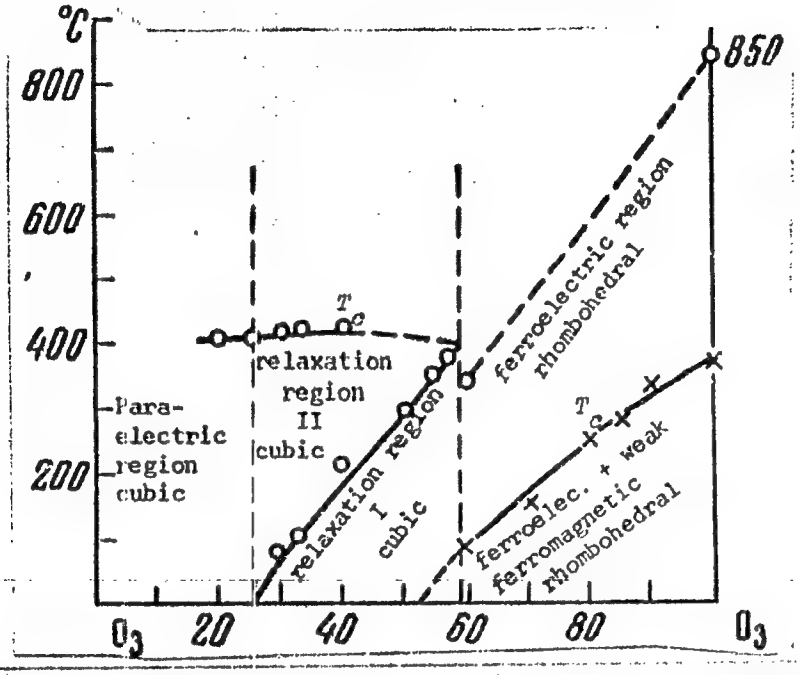

Fig. 1.

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L 57494-65 EWT(1)/EPA(s)-2/EEC(t, Pt-4/Pl-4 IJP(c) GG

ACCESSION NR: AP5016152 0048 UR/4800/65/029/006/1047/1050

AUTHOR: Shapiro,Z.I.; Fedulov,S.A.; Venevtsev,Yu.N.; Rigerman,L.G. 43 44 B

TITLE: Investigation of the lithium tantalate-lithium niobate system /Report, 4th All-Union Conference on Ferroelectricity held in Rostov-on-the-Don 12-18 Sept 1964/

SOURCE: AN SSSR.Izvestiya.Ser.fizicheskaya, v.29,no.6,1965,1047-1050

TOPIC TAGS: ferroelectricity, lithium compound, tantalum compound, niobium compound, solid solution, phase transition, dielectric constant, electric conductivity, x-ray measurement

ABSTRACT: The authors have investigated $LiTaO_3$-$LiNbO_3$ solid solutions in order to elucidate the dielectric properties of $LiNbO_3$, those of $LiTaO_3$ being better known. The materials were prepared by the conventional ceramic techniques. The solid solutions were investigated by x-ray diffraction, apparently at room temperature. Lattice constants were measured with accuracies of 0.001 and 0.003 A. The lattice constants varied smoothly and monotonically with composition over the en-

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ACCESSION NR: AP5016152 O

tire range. The distortion and volume of the unit cell increased with increasing $LiNbO_3$ content. Dielectric constants were measured at temperatures up to 1000°C; measurements at higher temperatures were not possible because of the increase of conductivity with temperature. The dielectric constant peak was observed in all samples containing less than 70% $LiNbO_3$. The maximum value of the dielectric constant increased with increasing $LiNbO_3$ content. Extrapolation of the temperature of dielectric constant peak to pure $LiNbO_3$ gave a Curie point for this material roughly equal to or somewhat higher than its 1170°C melting point. The logarithm of the conductivity was for all samples a linear function of the reciprocal temperature, except that in some samples there was a small kink in the curve near the Curie point, such as is characteristic of ferroelectric phase transitions. Such an anomaly occurred near 600°C in the curve for pure $LiNbO_3$; this is ascribed, however, not to a phase transition, but to "some changes in the magnitudes of the electronic dipole moments due to a discontinuous shift of the relative displacements of the separate ions". It is concluded that $LiNbO_3$ is a "frozen" ferroelectric or a pyroelectric. A thorough

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ACCESSION NR: AP5016152

structural analysis of this system over a wide temperature range is desirable. Orig.art.has: 4 figures.

ASSOCIATION: VNII IRYeA

SUBMITTED: 00 ENCL: 00 SUB CODE: SS,IC

NR REF SOV: 004 OTHER: 006

Card 3/3 dm

L 7835-66 EWP(e)/EPA(s)-2/EWT(m)/EWP(i)/EPA(w)-2/EWP(t)/EWP(b)/EWA(h)
ACC NR: AP5028118 IJP(c) JD/WH SOURCE CODE: UR/0048/65/029/011/2050/2054

AUTHOR: Fedulov,S.A.; Fel'dman,N.B.; Rodicheva,Ye.N. 78

ORG: All-Union Scientific Research Institute of Chemical Reagents and High Purity Chemicals (Vsesoyuznyy nauchno-issledovatel'skiy institut khimicheskikh reaktivov i osobo chistykh khimicheskikh veshchestv)

TITLE: Investigation of lead titanate - lanthanum titanate solid solutions /Report, Fourth All-Union Conference on Ferro-electricity held at Rostov-on-the Don 12-16 September 1964/

SOURCE: AN SSSR. Izvestiya. Seriya fizicheskaya, v. 29, no. 11, 1965, 2050-2054

TOPIC TAGS: ferroelectric material, piezoelectric ceramic, solid solution, lead, lanthanum, titanate, dielectric constant, dielectric loss, Curie point, lattice parameter, electric polarization, piezoelectric modulus

ABSTRACT: The ferroelectric and piezoelectric properties of $(1 - x)PbTiO_3 + xLa_{2/3}TiO_3$ solid solutions were investigated. The specimens were synthesized from the oxides by a special ceramic technique described in an Inventor's Certificate by I.A.Grozman, L.Z.Rusakov, and N.B.Fel'dman (Avtor. svid. No. 135394 ot 25 marta 1960) and involving 2-hour roastings at 910 and 1180-1270°C. X-ray studies showed that solid solutions were formed for values of x up to 0.5 and above. The volume of the unit cell decreased with increasing x; from this it is concluded that the trivalent

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ACC NR: AP5028118 O

lanthanum ions replace the divalent lead rather than the tetravavelent titanium ions. The dielectric constant and electric conductivity were measured at different temperatures, dielectric hysteresis loops were observed, and the piezoelectric properties were investigated by the resonance method. The solid solutions showed both ferroelectric and piezoelectric properties. The Curie temperature decreased with increasing x from approximately 500°C for x = 0 to 0°C for x = 0.5; this decrease of the Curie temperature is ascribed to the fact that the trivalent lanthanum ions are considerably less polarizable than the divalent lead ions that they replace. The radial electromechanical coupling constants of polarized specimens ranged between 0.1 and 0.2, the piezoelectric activity increasing with increasing x. The electric conductivities of the solid solutions were in general less than that of pure lead titanate. By extrapolating hysteresis loop measurements to x = 0, values of 4 kV/cm and 50 $\mu C/cm^2$ were found for the coercive field and spontaneous polarization of lead titanate. This value of the polarization is in good agreement with the finding of G.Shirane and S.Hochino (proc. Inst. Rad. Engrs., 43, No. 12, 1738 (1955)), but the value 90-100 $\mu C/cm^2$ calculated from the latent heat of the phase transformation is believed to be more nearly correct. The discrepancy is ascribed to the use of ceramic specimens rather than single crystals. It is concluded that the investigated materials will find practical application, owing to their rather high Curie points and their appreciable piezoelectric activities. Orig. art. has: 6 figures.

SUB CODE: SS,EM,ME SUBM DATE: 00/ ORIG. REF: 007 OTH REF: 005

Card 2/2 bjp

L 12102-66 EWT(1) IJP(c) IHB/GG

ACC NR: AP6000532 SOURCE CODE: UR/0070/65/010/006/0869/0874

AUTHOR: Shapiro, Z.I.; Fedulov, S.A.; Venevtsev, Yu. N.; Rigerman, L.G.

ORG: All-Union Scientific-Research Institute of Chemical Reagents and Very Pure Chemical Substances (Vsesoyuznyy nauchno-issledovatel'skiy institut khimicheskikh reaktivov i osobo chistikh khimicheskikh veshchestv)

TITLE: The study of phase transitions in $LiNbO_3$ and $LiTaO_3$ compounds

SOURCE: Kristallografiya, v. 10, no. 6, 1965, 869-874

TOPIC TAGS: lithium compound, ferroelectric material, phase transition

ABSTRACT: Although B.T. Mattias and J.P. Remeika (Phys. Rev. 76, 1886, 1949) discovered in 1949 that $LiTaO_3$ and $LiNbO_3$ exhibit unique dielectric properties, these dielectric properties and the nature of polymorphic transitions of the compounds have not yet been thoroughly studied. Consequently, the authors studied within a 0 - 1000C temperature range the structure (using x-ray diffraction) and electrical properties (a.c. bridge) of these compounds. A brief description of the sample preparation and experimental methodology is followed by a presentation (in the form of graphs) of x-ray, dielectric, and conductivity data. The article concludes with a brief discussion of the results. The $LiTaO_3$ compound contains a ferroelectric transition at 630C, whereas $LiNbO_3$ is, apparently, a "frozen" ferroelectric. The authors express their thanks to V.S. Kharitonov for his help during the investigation.

UDC: 548.736:536.42

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